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CHEMICAL BROWN STAIN IN PINE

Stains that develop in logs and lumber are usually produced either by fungi or by chemical changes that occur in the water-soluble extractives. Although the stains produced by fungi are more common and cause greater financial losses, the chemical stains may become troublesome during the seasoning of certain species. Among the commercial species that are subject to objectionable chemical stains are ponderosa pine, the true white pines, western hemlock, Noble fir, redwood, and several hardwoods, including maple, birch, hickory, persimmon, basswood, and magnolia. Chemical brown stain in pine is not expected to appreciably alter the physical properties of the wood other than that of appearance.

Occurrence of Stain

Chemical brown stain in the pines darkens the wood to colors ranging from buff to dark brown. It is usually most conspicuous at or near the surface, but may penetrate throughout the wood. The stain is more pronounced in areas where most evaporation occurs, as at end surfaces and on tangential surfaces.

The occurrence of brown stain is closely associated with the drying of wood. It appears in the zone where the water vaporizes, thus depositing the solutes or extractives. The stain appears beneath the surface if the porosity of the wood and the severity of the drying conditions promote rapid drying of the surface fibers. Under such conditions, a steep moisture gradient is established with a moisture content of the surface fibers well below the fiber-saturation point. When the water moves so freely through the wood that the surface fibers remain moist for some time after exposure to a drying atmosphere, the stain tends to develop at or near the surface of the lumber.

In pine, chemical brown stain develops in either sapwood or heartwood. Very commonly it occurs in the area of the junction of heartwood and sapwood. Blue and brown stains due to fungi are generally confined to the sapwood only. Chemical brown stain is more prevalent in lumber sawed from old logs than in lumber sawed from newly cut logs. As recently shown by the Western Pine Association it is also more prevalent in boards that have been solid piled for two or more days immediately following sawing than in boards piled for drying immediately after sawing.

Cause of Stain

The exact nature of the chemical changes responsible for chemical brown stain is not fully understood. However, experience has shown that

the stain occurs only as the wood dries, appearing during both air drying and kiln drying. The degree of staining is influenced by the temperatures and relative humidity employed in drying, that is, a high temperature-high humidity drying schedule produces greater staining than does a low temperature-low humidity schedule. Warm and excessively humid conditions seem to increase brown stain in air drying.

Chemical brown stain is believed to be caused by chemical reactions that occur in the water-soluble extractives as they are concentrated and deposited during drying. Evidence for this belief was obtained when brown stain was produced in a nonstaining wood by impregnating it with an extract isolated from green sugar pine selected for its known tendency to brown stain in drying. Furthermore, sugar pine, freed from its extractives, could be dried under severe kiln conditions without stain. Additional work on the separation of the various chemical components present in extracts from staining wood showed that the principal stain producing substances are the sugars. A lesser degree of staining was produced by tannins. Further research is needed, however, to develop a complete chemical understanding of the brown stain phenomenon.

Control of Brown Stain

No completely successful way of preventing chemical brown stain is known. Certain means can, however, be recommended for limiting its occurrence.

The substance or substances responsible for the brown stain are insoluble or only moderately soluble in cold water, but are readily soluble in hot water. Therefore, the use of mild temperatures during seasoning will decrease the quantity of soluble material carried by the water toward the surface of the lumber, where it is deposited during the process of evaporation.

The temperature of the free water in wood at the start of a kiln run approximates the wet-bulb temperature. This is especially true of woods in which the movement of the water is rapid and the wood dries almost as fast as the moisture can be evaporated from the surface. Consequently, the wet-bulb temperature is an important factor to be considered in the control of brown stain, and it should be kept low, especially during the early stages of drying of stock that is likely to stain.

Since the zone of extractive concentration should be kept well below the surface, as low a relative humidity as is possible without developing serious surface checking should be maintained by proper ventilation. High air velocities are required when kiln drying wide truck loads of edge-to-edge piled stock to prevent excessive increases in the relative humidity of the air moving across the load.

As previously indicated, an important factor in the development of chemical brown stain is the length of storage of the logs and lumber. The most effective method of keeping brown stain to a minimum is to cut the logs into lumber soon after felling the trees and to avoid solid piling the green lumber for more than a day.

Brown stain develops less during air drying than during kiln drying, and thorough air drying prior to kiln drying, therefore, will reduce staining. This is particularly true of lumber that has been air drying during the cold winter months, when the least amount of stain-producing extractive is in solution.

Ponderosa pine lumber cut from freshly felled logs and promptly kiln dried with initial conditions of 120° F. and 55 percent relative humidity and final conditions of 160° F. and 24 percent relative humidity has a minimum of chemical brown stain. Eastern white pine is being kiln dried to produce commercially acceptable stock with initial conditions of 150° F. and 80 percent relative humidity and final conditions of 180° F. and 30 percent relative humidity.